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VOLUME XXXVI SAN FRANCISCO, MARCH 18, 1916 NUMBER 12

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STREET LIGHTING

BY CHARLES T. PHILLIPS.

(General consideration is here given to the several factors which combine to give satisfactory street illumination. The article should be of value to city officials or citizens interested in comparing different systems. The author is consulting engineer at San Francisco.—The Editor.)

The general subject of street lighting is such a broad one that it is impossible to cover all details without employing voluminous space. It is proposed, therefore, to consider only the fundamental principles without analyzing the details. The problem to be solved by the illuminating engineer is to produce the intensity required, with a consideration of the psychological effect, at a minimum cost. This cost includes all expenditures for energy, maintenance, depreciation, interest and amortization fund; not only for the lamps but for all auxiliary equipment. Our present methods of obtaining artificial light are very crude, our most efficient illuminant having an efficiency of only about 6 per cent. Therefore the value of scrutinizing every item so as to bring the efficiency to as high a degree as possible is obvious.

Road Illumination from Luminous Arc Lamps Equipped with Prismatic Refractors.

Street lighting presents many more difficulties than interior lighting. The area is great and consists of long, narrow strips, very little assistance is rendered by specular reflection; the hours of lighting are long; the installation cost is high; there is great liability of damage to the installation; the maintenance is high and there is excessive loss from dirt and dust. The intensity of light need not be high, providing it is fairly uniform. The load is one desired by the power company, due to the fact that most of the energy is taken "off the peak." These two factors are the only ones in favor of a street lighting installation when compared with interior lighting.

The lighting should be considered under at least five headings, each having several sub-divisions: streets devoted to retail trade where business is done to a large extent at night; streets in the wholesale and manufacturing district; residence streets; parks and boulevards, and thinly settled districts.

Street lighting equipment is frequently selected on the plea that it is giving satisfaction elsewhere. This method has lead to more unsatisfactory installa-

tions than it has satisfactory ones. In the first place how is it known that the installation "elsewhere" is giving good results? It is true that the streets may be well lighted, but at what cost? Was the installation carefully planned? Perhaps some other system would have been much more efficient and reliable than the one installed. The rapid development in lamps and auxiliary apparatus calls for a careful consideration of all devices on the market and last, but most important of all, is the consideration of local conditions.

In current consumption per candle power the arc lamp is more efficient than the incandescent, and the numerous improvements made in the mechanism and electrodes has brought the various types of arc lamps to a high degree of perfection. The luminous or magnetite arc and the flaming arc are perhaps the most used. The magnetite arc lamp, also called the luminous arc, gives a distribution and quality of light superior to the early types of arc lamps. The electrodes used in this lamp differ from those in other forms of arc lamps heretofore used. The upper electrode is of copper and the lower electrode is of magnetite, from which material the lamp derives its name. The life of the upper electrode is from 2000 to 8000 hours, and the lower, from 120 to 150 hours, depending upon the current adjustment. This lamp is made in various forms, each with different characteristics, such as current consumption, efficiency, light distribution and for either pendent suspension or mounting upon an ornamental post. The magnetite lamp is made for direct current series street lighting circuits, which requires special station apparatus.

Carbon arc lamps divide themselves into three classes, those that use solid carbons, cored carbons and flaming-arc carbons. The first two classes depend essentially, for their light producing, upon the continuous-spectrum radiation of highly heated carbon in the positive crater. The only purpose served by the cored carbons is the centralization of the arc. In the third class, however, the arc itself yields the principal share of emitted light. The most efficient lamp on the market today, in current consumption per candlepower, is the flame arc lamp. The characteristics of this lamp are high efficiency, the maximum light in the lower hemisphere, the color value of the light and the ability to change the color by impregnating the carbons with chemicals. These lamps are made for operation on both direct and alternating current and on series and multiple circuits. The principal objection to the flame arc lamp has been the delicate mechanism, the high cost of trimming and the depreciation in candlepower throughout the trim. These lamps are also made in various forms and for both pendent and post mounting. There are numerous makes of arc lamps on the market under different trade names, but the principle involved is more or less similar to the several types mentioned. There is quite a field for the different types of arc lamps, but it would be well to consider the various items of first cost, depreciation, current consumption, adaptability maintenance and reliability. It has not been considered good practice to make an installation of less than several hundred arc lamps, or to use arc lamps for the lighting of narrow streets where a low average intensity of light will be sufficient. The candlepower of the various arc lamps depreciates more or less from one trimming and cleaning to another and it might be advisable when using certain types to clean between trims.

The luminescent lamp, of which the quartz-tube mercury vapor is perhaps the best known, has not made much progress in this country, but is used to a large extent in European countries. This lamp has the next highest efficiency of any artificial illuminant, the flaming arc being the highest. There have been some marked improvements in the quartz-tube lamp recently and it promises to be a strong competitor of both the arc and incandescent lamps.

From the first incandescent lamp, with a filament of carbon and a current consumption of four or five watts per mean horizontal candlepower, to the present type of gas-filled lamps with an efficiency of 0.6 watt per candlepower, there has been quite a few steps through a number of important stages in lamp development. The incandescent lamp has been popular for both interior and exterior lighting, due to its ability to operate successfully under different conditions, its reliability, low maintenance, high efficiency in the late types and to the fact that it is made in a variety of sizes for street lighting, from 60 to 1000 candlepower.

There has been many attempts to combine the desirable features of the incandescent lamp and the arc lamp in one lamp, but until recently little progress has been made. There is now, in the experimental stage, an arc lamp with tungsten electrodes, operating within a sealed bulb, and it promises to give excellent results. The electrodes are not consumed, as is the case with the present types of arc lamps, and the efficiency promises to be higher than even the best gas-filled incandescent lamps.

The light flux, radiating from any source, may not give just the result desired or a large percentage may be lost. Consequently it is necessary that some means should be employed to control the light rays and direct them to the plane to be illuminated. This is done in various ways. A lamp may give just the desired distribution, if the mounting height and spacing is just right. As this condition is usually impractical, it becomes necessary to redirect the light by the use of reflectors or refractors.

There are numerous types of reflectors on the market, and, as a rule, it is possible to select a form that will fill the requirements, although occasionally the engineer is compelled to design a reflector to meet his needs.

As a point midway between the lighting units has the lowest intensity of light, it is desirable to strengthen the light at that point by concentrating most of the light emitted by the lamp to an angle that will project the light to the distant point.

Whether reflectors should be used or not and selection of the proper type depends upon other conditions. When the lighting has a strictly utilitation purpose, greater efficiency can be obtained by the proper use of reflectors. If ornamentation is desired or building facades are to be lighted, as well as the street, then perhaps the bare lamp or lamps, equipped with some form of diffusing globe, will give satisfactory results.

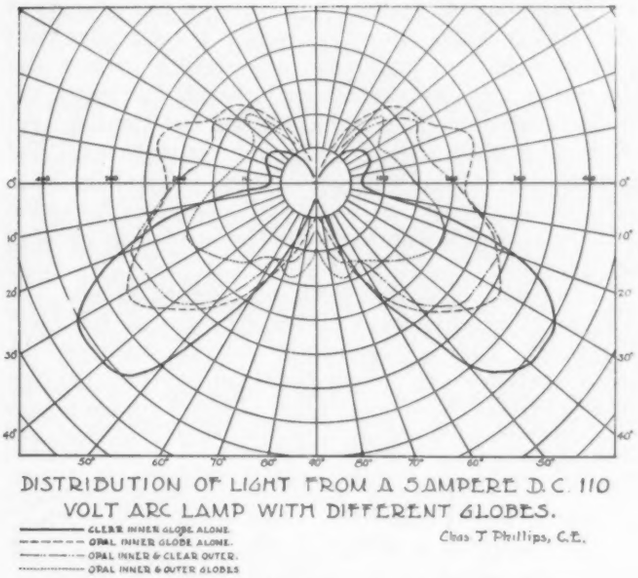
DISTRIBUTION OF LIGHT FROM A 5 AMPERE D.C. 110 VOLT ARC LAMP WITH DIFFERENT GLOBES.
CLEAR INNER GLOBE ALONE.
OPAL INNER GLOBE ALONE.
OPAL INNER & CLEAR OUTER.
OPAL INNER & OUTER GLOBES
Chas T Phillips, C.E.

Fig. 1. Effect of Glassware in Light Distribution.

It is hard to realize the effect that different glassware, or combinations of glassware, will have on the light distribution curve. Fig. 1 shows the effect on the distribution curve of an arc lamp. In the selection of glassware, the absorption factor should be given careful study, as this will vary from 15 to 80 per cent. Where glassware has selective absorption, the type of lamp with which it will be used should be considered. There is diffusing glass which is free from selective absorption and there are other kinds which give selective absorption in the red and yellow, and others, in the blue. It can be easily seen that if a diffusing glass which gives selective absorption in red and yellow is used with a flaming arc lamp, the rays that are the most brilliant will be absorbed strongly, thus giving a reduced efficiency.

It should be remembered that an item of extreme importance in a system of street lighting are the globes, shades or reflectors, because through them the greatest loss of illumination occurs.

Operating cost consists of so many variable factors that it can only be considered for each individual case. If the lighting is on a moonlight, all-night or midnight schedule, the effect upon the majority of the items of maintenance will be different and consequently there is no rule that can be followed. All-night service should obtain the lowest rate for current, all-night, moonlight schedule should obtain the next and the current cost for midnight service should be the highest.

The cost of electric energy is an important factor in street lighting and this cost will vary in different locations. The power company or municipal plant furnishing current will have to base the charge upon the annual load factor of the street lighting system, upon the fixed charges and also upon such variable charges as may enter into the generation of current. The quantity of current required during the peak load will have to be considered. It has however been customary for power companies to strike an average scale of rates to cover their entire system, although in special cases, where load-factor or other conditions are unusual, special rates are made. Street lighting, in most cases,

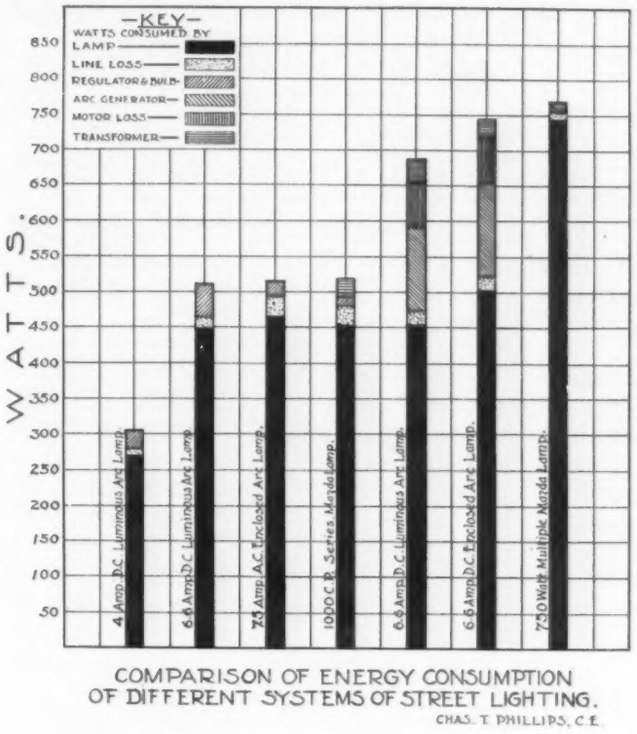

Fig. 2. Comparison of Energy Consumption of Different Systems of Street Lighting.

is an all-night load, and it is considered desirable business by most power companies.

Comparisons of energy consumption for different systems of street lighting are shown by Fig 2. This is a general comparison and is not intended to show in detail, the actual losses in all installations, as line losses, transformer efficiency, etc., will vary in each instance. It is assumed that energy is taken from the bus bars at 2200 volts, single-phase, sixty cycle.

"America's Electrical Week" has been selected by the campaign executive committee of the Society for Electrical Development, Inc., as the official name for the great electrical celebration, December 2 to 9, 1916. A start has already been made on the nation-wide campaign, which from every indication will surpass even the wonderful results accomplished by the 1915 "Electrical Prosperity Week." The name "America's Electrical Week" was chosen this year because of its timeliness, the patriotic thought it conveys, the national aspect the name indicates, its euhony, and its appeal to every citizen. The date is practically the same as that of last year, which was generally conceded to be the best time of the year, as it began the Christmas drive for big business. An advisory committee met at the offices of the society, March 1st, to discuss and take action on preliminary plans for the big movement. It was decided to have an open poster competition for the best design for the week. America's most prominent artists will be invited to participate. Cash prizes will be awarded for the most appropriate design. The contest will soon be announced throughout the country. Many new sales and publicity features will be introduced in the plans for the 1916 electrical week. The electrical industry knows what can be done by a concerted drive for business, and other business interests and the public at large have learned of the tremendous possibilities for an annual electrical week. The pioneer work has been done; a greater public interest in electricity has been created; there is a greater commercial spirit in the industry itself and both the industry and the public are in a more receptive mood.

INCREASING LOAD FACTOR IN ORDER TO DECREASE DETERIORATION OF ELECTRIC APPARATUS.

BY F. G. BAUM.

(Proof of the truth in the apparent contradiction that constant use prolongs the life of electrical equipment is here given. Mr. Baum is a consulting engineer at San Francisco.—The Editor.)

The physical characteristics of the material used in electrical insulation are quite different from the metals and other materials with which they come in contact in electrical apparatus.

The specific heat, conductivity and temperature coefficient of expansion of insulating materials are quite different from copper, steel, air, oil, etc., with which they come in contact. Under temperature changes therefore there must necessarily be relative movement between the insulating material and the materials with which they come in contact. And since the insulating materials are all weak physically, they are more or less damaged by the relative motion occurring due to expansion and contraction as a result of temperature changes. The only way to avoid the damage to the insulation is to avoid the temperature changes in order to have no relative motion.

This means, of course, that all insulating materials should be maintained as nearly as possible at one operating condition. The way to do this most effectively is to keep, as nearly as possible, a constant output. This means that there is less deterioration in electrical apparatus if kept constantly in operation at one operating temperature than there will be if operated intermittently.

A generator that is operated very hot over the peak is damaged to a certain extent each time it is taken out of service and cools. If this is repeated each day the cumulated damage will, after a time, cause a break down. The same is true of nearly all electrical apparatus.

If a water pressure pipe line is emptied on a hot day more or less damage is done, and the action in a generator and other electrical apparatus is very much the same. We avoid temperature changes in pipe lines, and we should avoid them in electrical apparatus as far as possible. It is usually better to keep the temperature up than to have damage done by temperature changes.

That most of us have experienced less trouble as electric systems have increased their load factors is not then altogether due to improvement of apparatus, but largely to the fact that the apparatus deteriorates less when in continuous use than when used only a few hours a day. In this respect electrical apparatus differs from most other machinery and plant equipment. A more general recognition of this principle by electrical managers will make them more keen for business that keeps all apparatus at work as much as possible.

A generator of the enclosed, forced-ventilation type has less deterioration than the open type, partly because of better and more positive ventilation, but largely because of the more even temperature of the windings. Still better results will be obtained if we control the humidity of the air going to the generator.

The wonderful operating results of the oil type of transformer is due almost entirely to the fact that temperature changes are reduced resulting in less deterioration in coils and oil, and the oil lubricates the surfaces which rub in expansion and contraction. An oil type of transformer under one constant load and temperature should operate almost indefinitely with little deterioration. Cold oil will cause condensation and the absorbed water reduces the insulating value of the oil.

The same principle holds for motors, meters, underground and overhead cables, etc., and all insulated wires and material, and it is best to maintain the entire system under steady load and constant temperature as far as this can be done. This of course means that we should build up the load factor to decrease deterioration.

Even high tension transmission lines are maintained in better condition when continuously "hot" even when the line is not required to carry the load. Under the action of the electrical stress the porcelain insulators are maintained in better operating condition when normal voltage is maintained on the line than if the line is taken out of service daily. The practice of some companies in taking transmission lines out of daily service when not needed is therefore wrong.

The pin type of insulator is subject to less strain due to temperature changes than is the suspension type, as is shown in actual experience. This may be due to the better protection and less rapid temperature changes of the pin type. Perhaps the failure of suspension insulators would be materially reduced if constant potential were kept on the line.

In the operation of transmission lines for a large system I gave orders fourteen years ago to keep all lines in service except in case of trouble or when necessary to make repairs. Reliable data as to the causes of failures of suspension type insulators is needed.

It is fortunate for the electrical industry that the deterioration of insulating materials is less when the apparatus is kept at work than when idle, and hence there should be every attempt made to increase the load factor of the system.

And inasmuch as better load factors mean reduced capital cost and more revenue, in addition to less deterioration, it is important for the industry as a whole that this principle of constant use to reduce deterioration should be more generally appreciated. The wisdom of the policy of such men as Mr. Insull, who believe in one general electrical system for an entire district, will be appreciated more as the electric system becomes better known.

Electric cooking is to be taught in the domestic science department of the Oregon Normal School at Monmouth. The Oregon Power Company is furnishing the current.

Ultra-violet radiations from arc lamps and sunlight kills living cells by changing the protoplasm so that certain salts can combine with it to form an insoluble compound or coagulum.

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix I—Estimate of Capital Cost and Annual Cost of Power.

(Concluded.)

Contingent margin. The total cost of each item as given in the estimates which follow all include a margin of 25 per cent to cover engineering, administration during construction, and contingencies in addition to the amounts obtained by applying the foregoing unit prices, except in the case of the generating machinery; in this case only 15 per cent was allowed, as these estimates are based upon the higher of two or more actual quotations in nearly all cases, and the manufacturer himself would furnish the engineering talent except for erection, which item has been included in the estimate.

ESTIMATE OF CAPITAL COST.

Dam for Closing Present Channel:		
Scheme A (Fig. 31) + 25 cer cent.....	$3,325,000	
Scheme B (Fig. 31) + 25 per cent.....	2,288,000	
Scheme C (Fig. 31) + 25 per cent.....	3,344,000	
Scheme D (Fig. 31) + 25 per cent.....	3,056,000	
Scheme E (Fig. 32) + 25 per cent.....	3,485,000	
Scheme F (Fig. 32) + 25 per cent.....	3,419,000	
Use for estimate		$3,350,000
Controlling Dam:		
Camere type of dam; approximate quantities as designed for 81 ft. controlled depth.		
25,000 tons structural steel.		
4,000 tons cast steel.		
230,000 cu. yds. of concrete.		
1 traveling gantry crane.		
Estimated cost, reduced 25 per cent, for 67 ft. controlled depth plus 25 per cent contingent fund	$3,851,000	
Tainter gate type of dam, approximate quantites as designed for 81 ft. controlled depth.		
41,600 tons structural steel.		
21,800 tons cast steel.		
480 tons steel cable.		
312,450 cu. yds. concrete.		
Estimated cost, reduced 25 per cent, for 67 ft. controlled depth plus 25 per cent contingent fund	8,837,000	
Use for estimate of controlling dam...		$8,837,000
Flood Channel:		
Approximate quantities:		
2,078,000 cu. yds. rock excavation, above elevation 84.0 (sill of flood gates) plus 25 per cent		$2,078,000
Diversion Channel:		
Approximate quantities:		
1,243,000 cu. yds. rock excavation for diversion channel below elevation 84.0.		
140,500 cu. yds. concrete.		
810,000 F.B.M. timber for cribs.		
8,000 cu. yds. rock fill in cribs.		
Estimated cost of diversion channel and closure of same plus 25 per cent.		2,872,000
Ice and Drift Sluice, Oregon Side:		
Approximate quantities:		
252,000 cu. yds. rock excavation.		
28,300 cu. yds. concrete.		
320 tons structural steel rollers.		
Estimated cost plus 25 per cent.....		452,000
Wing Walls for Rock Fill Dam:		
Approximate quantities:		
42,500 cu. yds. concrete plus 25 per cent		266,000
Main Floating Boom and Piers:		
Approximate quantities:		
11,394,000 F.B.M. of timber.		
1,055 tons of rods and drift pins.		
3,000 cu. yds. concrete.		
46,000 cu. yds. rock fill in piers.		
Estimated cost plus 25 per cent.....		493,000
Power Canal:		
Approximate quantities:		
4,229,000 cu. yds. rock excavation.		
136,000 cu. yds. rubble walls.		
17,960 cu. yds. concrete lining.		
1,000,000 cu. yds. sand excavation.		
Two floating booms.		
22,000 cu. yds. concrete.		
110 tons structural steel roller dams.		
Estimated cost plus 25 per cent.....		$5,394,000
Jetty at Intake to Power Canal:		
Approximate quantities:		
4,430,000 F.B.M. of timber.		
665,000 pounds rods and drift pins.		
2,470 cu. yds. reinforced concrete.		
164,000 cu. yds. rock fill.		
73,000 cu. yds. sand excavation.		
Estimated cost plus 25 per cent.....		285,000
Rebuilding Five Mile Lock:		
Raising walls and gates and building draw span, plus 25 per cent.....		106,000
Forebay and Power House Substructure:		
(Location A, Fig. 7.)		
Approximate quantities:		
1,584,000 cu. yds. dry rock excavation.		
137,500 cu. yds. rock excavation for removal of coffer dam.		
429,250 cu. yds. concrete.		
5,000,000 pounds steel reinforcement.		
3,500,000 pounds structural steel for penstock gates.		
2,300,000 pounds cast steel for penstock gates.		
1,024,000 pounds steel trash racks.		
24 filler gates and drain gates.		
$375,000 for cofferdamming and pumping.		
Estimated cost plus 25 per cent.....		$5,852,000
Power House Superstructure:		
76 ft. x 1670 ft. station building.		
Fishway.		
Tunnel through building for railroad.		
Steel bridges for spanning forebay and tailrace.		
Estimated cost plus 25 per cent.....		$1,475,000
Power House Machinery:		
23 vertical shaft, 35,000 kw. (50,000 k.v.a.). 25 cycle, 11,000 volt, 75 r.p.m. 3-phase generators, including stator and rotor, but not shaft or bearings.		
23 mechanically driven exciters, 500 kw. each; switchboard, low tension oil switches, bus bars, and all miscellaneous electrical equipment.		
23 50,000 h.p. vertical shaft, 75 r.p.m. turbine units including shaft and all bearings, governors and oil system.		
2 250-ton traveling cranes in power house and 2 50-ton traveling gantry cranes serving penstock gates; miscellaneous small equipment.		
Estimated cost plus 15 per cent.....		12,353,000
Reconstruction of Railroads:		
Total estimated cost plus 25 per cent..		687,000
Other Property Damage		904,000
Total physical cost		$45,404,000
Add for interest during one-half of five-year construction period at 4 per cent, equals 10 per cent.....		4,540,000
Total estimated capital cost		$49,944,000
Use for total capital cost		$50,000,000

Annual cost of generating primary power. The following items are independent of the interest rate on capital investment:

Depreciation—Reserve fund assumed to earn 2 per cent interest and sufficient to replace all depreciable parts every 15 years, and to refund the cost of all nearly permanent structures, rock excavation, concrete, etc., every 50 years (average value 3 per cent).....		$1,500,000
Maintenance and Repairs—For maintenance and repairs on the turbine units, in addition to depreciation fund, per annum	$112,800	
Maintenance and repairs to generators and electrical equipment, 1½ per cent	74,000	
Repairs to movable dam	50,000	
Painting, average of one coat per annum, 43,700 tons of exposed steel (total in use) at $1 per ton.....	43,700	
Operating suction dredge to prevent possible accumulation of sand bar at canal intake, 300 days, $100 per day.	30,000	
Maintenance of building, replacing roof every 5 years, plus 50 per cent for other repairs	2,400	
Contingent maintenance and repair expense	50,000	
Total for maintenance and repairs.....		$362,900
Attendance and administration		100,000
Total annual expense exclusive of interest		$1,962,900

The rate of interest to be paid on the capital investment will depend largely upon the basis of financing. To show the relation of this to the annual cost

of power, interest rates of 3 and 4 per cent have been assumed as representing public development under different conditions. There has also been assumed a rate of 6 per cent on securities originally discounted 10 per cent, plus 1 per cent taxes, this basis being intended to represent approximately the cost under corporate financing. The results are as follows: No sinking fund has been provided as it is not properly chargeable to the cost of generation. The depreciation or amortization fund would provide for keeping the project permanently in first class operating condition. A water power property is of such unquestionably permanent value as to make it unnecessary to recover the principal in a short time as with many industrial enterprises which are subject at any time to the necessity of complete liquidation due to unforseen competition. In the case of corporate finance, especially, a sinking fund might, however, assist in securing easier terms in marketing the securities but in any event is amply covered by the 25 per cent contingent fund. A 50 year sinking fund drawing 2 per cent interest would involve an annual expense of $1.20 per continuous electrical horsepower.

Three per cent basis:

Depreciation, maintenance and repairs as above		$1,962,900
3 per cent interest on $50,000,000		1,500,000
Total annual charges		$3,462,000
Annual cost per peak electrical horsepower year of base load (480,000 h.p.)	7.22	
Add 25 per cent	1.80	
Use	$ 9.02	

Four per cent basis:

Depreciation, maintenance and repairs as before		$1,962,900
4 per cent interest on $50,000,000		2,000,000
Total annual charges		$3,962,900
Per peak horsepower year	8.27	
Add 25 per cent	2.07	
Use	$10.34	

Six per cent basis:

Depreciation, etc., as before		$1,962,900
Add for 6 per cent on securities originally sold at 10 per cent discount, equivalent to 6.67 per cent		3,340,000
Add for taxes 1 per cent		500,000
Total annual charges		$5,802,900
Cost of power on usual basis of private enterprise per peak horse power per year	12.10	
Add 25 per cent	3.03	
Use	$15.13	

Cost of generation contingent upon sale of surplus power. If the sale of the surplus power is to be assumed, then an additional item of depreciation should be added to provide for the possibility of severe runner erosion for the low head units when operating at heads above 80 ft. The value of one runner including freight and erection would be about $27,000.

About seven low head units are required to operate at 80 ft. head to produce 800,000 h.p. with a decreasing number at the higher heads where the erosion would be most severe. If we assume to replace all seven runners every three years, the annual additional charge would be $63,000, say $75,000. This item is very small compared with the additional profit which the surplus power should bring.

It might be assumed roughly that 11 months' surplus power be worth 80 per cent of the value of continuous power, 10 months' power 60 per cent and 8 months' power 30 per cent.

If the various prices now be weighted according to the amount available, and using the price of primary power as unity, there will result:

480,000	× 1.00	=	480,000
120,000	× .80	=	96,000
100,000	× .60	=	60,000
100,000	× .30	=	30,000
800,000	actual	or	666,000 weighted power

The quotient of these totals or 0.8333 now represents the average unit value of all power, as a proportion of the value of primary power, and 666,000 represents the equivalent primary power to produce the same income. If all power were to be sold at prices bearing the above ratio to each other, the actual costs of production of primary power would then be obtained by first adding $75,000 to the annual charges and then dividing by 666,000.

Based upon 3 per cent interest:

Former annual charge		$3,462,900
Add for runner depreciation		75,000
Total		$3,537,900
Add 25 per cent		884,000
Use		$4,421,900
Cost per peak primary horsepower	6.63	
Cost per 11 mo. surplus h.p.	5.30	
Cost per 10 mo. surplus h.p.	4.00	
Cost per 8 mo. surplus h.p.	2.00	

Based upon 4 per cent interest:

Former annual charge		$3,962,900
Add for runner depreciation		75,000
Total		$4,037,900
Add 25 per cent		1,009,500
Use		$5,047,400
Cost per primary horsepower	7.58	
Cost per 11 mo. surplus h.p.	6.06	
Cost per 10 mo. surplus h.p.	4.55	
Cost per 8 mo. surplus h.p.	2.27	

Based upon 6 per cent interest—on securities sold at 90:

Former annual charge		$5,802,900
Add for runner depreciation		75,000
Total		$5,877,900
Add 25 per cent		1,469,500
Use		$7,347,400
Cost per primary horsepower		$11.02
Cost per 11 mo. surplus h.p.		8.82
Cost per 10 mo. surplus h.p.		6.62
Cost per 8 mo. surplus h.p.		3.31

The computations for the capital cost and cost of power for the case in which a period of ten years was allowed for building up the load, were made by starting with the initial investment necessary to deliver one-tenth of the power, and then progressively adding for each year the deficit, or difference between interest on the previously accumulated investment, operating expenses, etc., and the earnings of the year in question, to the investment of the previous year. It was necessary to first assume a price of power and, after computing the transactions of the ten-year period, to then correct this assumption by a process of successive approximations until an assumption was made which provided the desired 25 per cent margin at the end of the ten-year period. The results of these computations were tabulated in an earlier part of this chapter.

Wireless telegraphy and telephony is considered in the annual report of the Postal Telegraph Cable Company as being of "incalculable value for the protection and direction of ships and for the changing conditions of the battlefield or other places where poles, wires or cables cannot well be erected or maintained, but nothing has caused your trustees to change or modify their opinion that, as commercial propositions, wireless telegraphy and wireless telephony are and will continue to be negligible."

ELECTRIC IRRIGATION PUMPING IN IDAHO.

BY W. T. WALLACE.

(After tracing the recent increase in irrigation pumping and detailing its advantages over gravity supply, the author cites the results of recent survey conducted by the power companies, wherein it was developed that plant efficiency rather than power rates was the most important factor in power costs. This paper was presented at the annual convention of the Idaho Society of Engineers, at Burley, Idaho, February 22, 1916.—The Editor.)

Past Progress.

Lifting irrigation water direct by means of current wheels has been practiced for many years in Idaho. The new era of electric pumping is no more than well started. The first installations, few in number and of small capacity, were first operated in the summer of 1908. Their success led to many installations the following year. Within the last five years the growth of this business has been rapid and most of the large projects have been installed within that period. Up to the season of 1915, within the territory now supplied by the Electric Investment Company, a total of 16,005 h.p. in motors had been installed for irrigation pumping to water a total of 100,141 acres. One hundred and fifty individual plants, rated at 798 h.p. total were in use, watering 5953 acres, the average capacity being 5.3 h.p. Among these are 131 plants ranging from ½ to 7½ h.p., inclusive, with a total rating of 478 h.p., and an average rating of 3.6 h.p., and 19 plants ranging from 10 to 35 h.p., with a total of 320 h.p. connected load, with an average rating of 16.8 h.p. This shows that by far the greater number of individual plants are of very small capacity.

There were 87 irrigation projects in operation in 1915, with a total of 15,207 connected h.p. for watering 94,188 acres. The average size of plant was 175 h.p., and the average acreage was 1803. The maximum lift was 200 ft., and the average lift was 94.7 ft.

Field for Pumping.

There is no sharp dividing line between the economical field for irrigating by gravity systems and by pumping plants. As a general rule, the gravity system is to be preferred where water can be supplied at a lower cost than by pumping. However, there have been numerous cases where long stretches of bad side hill construction through dangerous ground have been necessary for gravity systems, resulting in washouts, sinking ground, replacement of dirt sections by pipe lines or flumes, which in the end have made the cost of maintenance so excessive that a pumping plant would have been more economical, although the original estimates gave the advantage to the gravity system. The pumping plant has an important advantage in regard to insurance of service. A gravity system supplied by a single long canal is subject to many interruptions from treacherous side hill construction, cloudbursts and washouts caused by gophers, muskrats and crawfish, which are not experienced with large pumping systems having several canals of short length in comparatively flat ground.

There are large tracts of fertile land lying along the Snake River which can be watered under reasonable pumping lifts, but for which a gravity system is impracticable because of the extreme length of canal necessary, due to the flat grade of the river. The water supply for such lands is still abundant, and there should be no restriction as to installation of additional pumping systems for this reason for many years, particularly along that part of the Snake River west of Hagerman. There are several thousand second feet flowing into the Snake River from many large springs above this district, such as the Thousand Springs, Box Canyon, Clear Lake and the Malad River, which will insure an ample water supply although the river above may be absolutely dry.

There is a large field for small individual pumping plants watering lands lying above the present gravity ditches. Such plants cannot be of high lift, as lands so watered must bear their share of the first cost and the maintenance charges of the gravity system, in addition to their pumping installations and power charges. A great many small installations of this type are proving profitable to their owners, and doubtless many more will be installed. It is often possible to water considerable tracts of land above such ditches with a total lift not exceeding 10 ft., in which case the additional power charge per acre is not an excessive burden to add to the regular canal charges. In some cases the water for such lands is supplied at a less charge for the canal rights than paid by the lands beneath the ditch, which encourages the watering of the higher lands.

In many of the western states water from wells is one of the chief supplies for irrigation pumping. This field has been but slightly developed in Idaho, but will doubtless grow in importance as other supplies are exhausted and as the level of the ground water under large tracts is raised by other irrigation systems. The pumping of irrigation water from wells has peculiar advantages to the irrigator, because of the fact that such water does not carry and spread upon the land the seeds or means of propagation of weeds and other rank growths as does the water supplied from long, open ditches. This same advantage exists, to at least some extent, in favor of all pumping plants because of the shortened length of canals.

Irrigation Pumping Investigations.

At the time of these original installations high efficiency stock centrifugal pumps were not on the market, and the importance of selecting efficient machinery, suited to the characteristics of the special case, as well as the necessity for proper installation, were not fully appreciated. Furthermore, proper advice was not always readily obtainable, and the dealer who offered the cheapest equipment and who represented that it would deliver the required water, often secured the order, regardless of efficiency, durability or economy. A better understanding of the necessities of the irrigator, but particularly the manufacture of small stock pumps having greatly increased efficiencies, have tended during the past two years to smooth out some of these early difficulties, but there is still a great deal to accomplish in this direction.

In the summer of 1913 the Bureau of Irrigation Investigations of the Department of Agriculture secured records of a number of pumping installations in the Payette district, from which the plant efficiency, power consumption, duty of water, etc., were learned.

In the spring of 1915 the various power companies operating in the southern part of Idaho decided to make a thorough investigation of the pumping situation. All possible data were secured that would throw light on every side of the question. Complete records for 1914 were collected so far as they were available. In many cases it was impossible to secure the necessary information, as no records had been kept by the owners. Accurate tests of the efficiency of more than eighty plants were made during the season of 1915. These investigations were pushed during the summer and the tabulation of all returns was completed during October.

A surprising variation in results was disclosed. Among the private pumping plants ranging from 1 to 35 h.p., the cost of power in dollars per acre varied from $1.25 for an eighty-acre tract supplied by a 4 in. pump under a 21 ft. head, to $60 for a one-acre orchard supplied by a 3 in. pump under a 30 ft. head; the season load factor was from 7/10 of 1 per cent to 66.9 per cent, and the price paid per kilowatt hour under these conditions ranged from 9/10c to 48.2c at the same power rate. The combined efficiency of motor and pump varied from 5 per cent in the case of a 1½ in. pump and 8 per cent for a 2 in. pump to 46 per cent for a 2 in. and 63 per cent for a 10 in. pump. The cost of power for lifting an acre foot of water one foot was from 3c to 68c among the plants for which this calculation was made, which did not include all those tested.

Among the irrigation projects, including all the large installations in the state, the variation in cost per kilowatt hour was from 72/100c to 1.56c; the load factor for the season was from 34 per cent to 67 per cent; and the cost of power per acre foot per foot lift was from 1.6c to 4.2c. It should be stated, however, that in many cases information was incomplete, both for individual installations and irrigation projects. Doubtless complete data would have shown wider variations than those mentioned.

As a rule, the owners of irrigation plants were entirely in the dark as to suitability of their equipment or as to the efficiency at which they were operating. Water which had been pumped at large cost was often badly used and needlessly wasted. Motors were being operated at from 49 per cent to 124 per cent of rated capacity, while the power was supplied on a flat rate based on the manufacturer's rating of the motor. Many suction and discharge lines were found to be undersize for the best economy and obstructed by needless short radius 90 deg. bends, valves, and miscellaneous pipe fittings, which greatly increased the effective head.

Many users of power for irrigation purposes had complained regarding the power rates, and the Utilities Commission had taken the whole matter up for investigation, and it was by reason of these facts that the power companies undertook as elaborate and careful an investigation as time permitted, and as many tests as possible were conducted to determine the efficiency of existing plants, all to the end that as much light as possible might be thrown on the problem of arriving at equitable rates for this service.

In the vast majority of cases all consumers of power for irrigation purposes had been using such power on one form or another of flat charge, based almost entirely on the manufacturer's rating of the motor, and the above investigations and tests disclosed the fact that many users of power under these rates were in the habit of starting up their pumping plants at the beginning of the irrigation season and letting them run continuously throughout the season, in many cases making no use of the water so pumped except to let it run down the hill again into the canal or river from which it may have been taken.

On the other hand, many users of power were making as economical a use of the service as was possible for them to do, all things considered.

The tests early developed the fact that in many cases the problem was not so much a question of power rates as it was a question of plant efficiency, and this is a matter which it is not always easy to get the irrigator to understand. If one of these irrigators had an efficient plant installed, and was operating the same, and then had deliberately permitted from fifty to seventy-five per cent of the water pumped to run back into the waste ditch, and had undertaken to irrigate his land with the remainder of the water not so wasted, he perhaps, would have hesitated some before severely criticizing the power rate, but as a matter of fact, many irrigators were, in effect, doing this same thing, except that the cause was, perhaps, hidden under poor plant efficiency.

A thorough consideration of all the various angles of this matter which were brought out by this investigation, and by the tests made, early forced the conclusion that an equitable rate for this service must be measured service and not a flat rate, because it is under a measured service only that the careless user of the service can be required to suffer from his own negligence and waste, and it is only under a measured service that the economical user of it is rewarded for his economy.

Irrigation Power Rates.

The growth of the irrigation pumping load has been such during the past four or five years as to cause the maximum load on the generating stations of the power company to occur during the summer months, when the irrigation load is being carried. This fact, when regarded from the standpoint of the power company, means, therefore, that the size of its installations at its generating plants and at its various distributing substations, is determined by the irrigation load, and as the use of power for this purpose is a seasonal use, and is not continuous throughout the year, and as the generating station capacity and substation capacity so used during the summer months, is, to a large extent, idle throughout the balance of the year, it becomes apparent that any equitable irrigation rate must have incorporated in it that element of charge which is, in our business, designated as a demand charge, or in other words, a charge designed primarily to compensate, in a measure at least, for the accruing interest charges on the investment of the power company in generating stations, transmission lines and substations.

The rates which are hereinafter set out will show that the demand charge is placed at $12.00 per h.p. per annum, which, when compared with similar charges made and enforced by power companies generally throughout the country, is found to be a more than usually low charge.

After extended hearings before the Idaho Public Utilities Commission, during which all sides of the pumping situation were thoroughly considered and at which all parties interested, including representatives of important pumping projects, water users' associations, etc., were present and took active part, a new schedule of irrigation pumping rates was agreed upon and authorized by the Utilities Commission under which all power is to be supplied on a meter basis at a considerable saving to the average consumer. Although the new rates were not issued until December 14, 1915, all power supplied during the season of 1915 was billed according to them. These rates apply to all irrigation customers from Pocatello to Huntington, but many plants are operating under old power contracts which have some years yet to run and under which they can continue should the owners so elect.

Equitable power rates must be based on many considerations. They should be such as to encourage the economical use of power. This result cannot be secured under either a flat rate or a straight meter rate. The former tends toward wasteful use of kilowatt hours but keeps the size of motors down to the necessary requirements. The latter insures a fairly economical use of kilowatt hours but places no limit on the size of the installation. A customer will install a motor far in excess of his requirements in order to get the pumping done quickly, avoid caring for the water nights and Sundays, etc., which requires that an unnecessarily large portion of the generating equipment of the power company be reserved for his requirements. Consequently true economy for both the consumer and the power company can be insured only by a form of rate that will prevent waste of kilowatt hours and insure the minimum demand and maximum load factor for each plant. The irrigation rates authorized by the Utilities Commission provide for a moderate flat charge based on the maximum demand for the season and in addition, a kilowatt hour charge, the two resulting in very reasonable rates for either high or low load factors but encouraging the former. These rates are as follows:

RATE NO. 1.

For Installations of Less Than 14 Horsepower.

Demand Charge:
$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
5 cents per kw.-hr. for first 45 kw.-hr per horsepower of maximum demand per month.
½ cent per kw.-hr. for all current consumed over 45 kw.-hr. per horsepower of maximum demand per month.
Discount of 5 per cent on monthly bill if paid within 10 days from date of bill.
Maximum Bill:
The company, under this rate, will not bill the consumer for irrigation pumping service more than $28 net per horsepower of maximum demand for five months' service, nor more than $33.60 net per horsepower of maximum demand for six months' service.

RATE NO. 2.

For Installations of 10 Horsepower to Less Than 25 Horsepower.

Demand Charge:
$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
5 cents per kw.-hr for first 30 kw.-hr. per horsepower of maximum demand per month.
½ cent per kw.-hr. for all current consumed over 30 kw.-hr. per horsepower of maximum demand per month.
Discount of 5 per cent on monthly bill if paid within 10 days from date of bill.
Maximum Bill:
The company, under this rate, will not bill the consumer for irrigation pumping service more than $28 net per horsepower of maximum demand for five months' service, nor more than $33.60 net per horsepower of maximum demond for six months' service.

RATE NO. 3.

For Installations of 25 Horsepower to Less Than 100 Horsepower.

Demand Charge
$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
½ cent per kw.-hr. for all current consumed.
Discount:
Consumers using service under this rate will be entitled to quantity discount on their monthly bills as follows.:
First $100.00 of monthly bill. No discount.
Next $100.00 of monthly bill 5% discount
Next $100.00 of monthly bill 10% discount
Next $100.00 of monthly bill 15% discount
All over $400.00 of monthly bill 20% discount
Guarantee:
The consumer, under this rate, guarantees to pay the company for irrigation pumping service, a net minimum bill of $15 per horsepower of maximum demand for five months' service, or $18 per horsepower of maximum demand for six months' service.

RATE NO. 4.

For Installation of 100 Horsepower and Over.

Demand Charge:
$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
½ cent per kw.-hr. for all current consumed.
Discount:
Consumers using service under this rate will be entitled to a quantity discount on their monthly bills as follows:
First $1,000.00 of monthly bill 10% discount.
Next $1,000.00 of monthly bill 20% discount.
All over $2,000.00 of monthly bill 40% discount.
Guarantee:
The consumer, under this rate guarantees to pay the company, for irrigation pumping service, a net minimum bill of $15.00 per horsepower of maximum demand for five months' service, or $18.00 per horsepower of maximum demand for six months' service.

These rates cover irrigation pumping for a season of five or six months from April to September, inclusive. The maximum demand for Rates 1 and 2 is the horsepower rating of all motors supplied with service at any one time and for Rates 3 and 4 is the average of the four highest fifteen minute peaks in horsepower occurring at any time during the season, not more than one peak being counted in any one hour, and peaks being determined by curve drawing wattmeters.

The following table shows the low power rate which may be secured for various sizes of motors:

Cost of Power for Irrigation Pumping for Season of 180 Days.

Motor h.p.	Motor Efficiency.	Kilowatt Hour Load Factor.		Brake Horsepower Hour. Load Factor.	
		75%	100%	75%	100%
5	82%	1.14c	.855c	1.04c	.778c
15	84%	1.14c	.876c	1.01c	.778c
75	87%	.934c	.806c	.801c	.691c
100	89%	.896c	.786c	.751c	.658c
500	91%	.824c	.693c	.675c	.568c
5000	95%	.745c	.558c	.585c	.438c

At the close of the irrigation season the consumer may use current, not exceeding the pumping demand, for general power purposes at any point upon his premises, providing that the point of delivery by the power company is not changed. As the demand charge per year is the same whether this additional power is used or not, the service for the remaining six months is secured at the meter rate alone, resulting in a greatly reduced cost per kilowatt hour. The owners of individual pumping plants will find many uses for their motors for general purposes about the farm for which the cost of power under the low winter rate will be hardly a consideration.

The following table shows the cost of pumping an acre foot a foot high with motors operating at full

load and at 75 per cent and 100 per cent load factor for a season of six months.

The pump efficiencies assumed are for average lifts and may be secured with stock pumps up to and including the 75 h.p. set. Larger units should have pumps of special design.

Size.	Motor. Efficiency.	Pump Efficiency.	Combined Motor and Pump Efficiency.	Cost per Foot Acre Foot 75% L. F.	100% L. F.
5	82%	56%	46%	2.54c	1.90c
15	84%	63%	53%	2.20c	1.69c
75	87%	76%	66%	1.45c	1.25c
500	91%	79%	72%	1.17c	.99c
5000	95%	82%	78%	.98c	.73c

All of the above are single units with the exception of the 5000 horsepower installation which represents three or four units driven by synchronous motors.

Common Troubles of Pumping Systems.

Some of our large pumping projects have been created through the efforts of promoters who were ignorant or illy advised as to the fundamental requirements for success. Unreasonable pumping lifts were undertaken, and the cost of construction and maintenance was underestimated, the duty of water taken too low and no allowance made for seepage losses, which, with inflated land values, made it seem to the uninformed investor that the project had merit. Such projects are condemned at the beginning by their characteristics. In some cases it will, no doubt, be possible to reorganize and eliminate some of the higher lifts and wipe out a large part of the original investment, resulting in a modified project for which there is a probability of success. Some projects which might have been successful later have been installed 5 to 10 years ahead of their time. There is little hope for their immediate success, considering the price of equally good lands under gravity systems where the initial maintenance cost is moderate.

In order to make the illegitimate scheme as inviting as possible the cost of all equipment is skimped, cheap plants are installed, inadequate canal systems built, necessitating rebuilding and enlarging within a few years. If a project is legitimate in its fundamental characteristics, it may be given a severe handicap by such ill-advised reduction of first cost. The saving in power bills and general maintenance in a few years would wipe out the extra cost of a thoroughly efficient and substantial plant. For example, one of the important smaller irrigation districts was operating with equipment which gave it an overall efficiency of 52 per cent. This figure was so startling and the power charges had become so high that it was decided to rebuild the plant, which was done, the new equipment giving an overall efficiency of about 76 per cent, which will make a saving of approximately 32 per cent in the total power charge.

(To be continued.)

THE GREAT WESTERN ELECTRO-CHEMICAL COMPANY.

BY J. W. BECKMAN.

A transcontinental railroad without any feeders is as badly off as a power company with excess power, and no way by means of which it can stimulate the demand for it, and the development of same. Fully alive to this situation, the management of The Great Western Power Company started a research department, in charge of an electrochemist. This department's office was to study conditions, especially in reference to the electrochemical and electrometallurgical lines, in the section of California that is served by this power company.

Through such studies and investigations it was assumed that a foundation might be laid for developments of industries, of a character as mentioned above. After extensive investigations, it was conclusively shown that the conditions were such that various electrochemical industries could be operated successfully on the Pacific Coast. The one which at this juncture seemed more promising than any other, was the manufacture of caustic soda and bleaching powder, also known as chloride of lime, together with other chlorine products.

A company was organized in January of this year, under the laws of California, with the name of the Great Western Electro-Chemical Company, with a capital of $2,500,000. Eastern, as well as Western capital is represented in the organization. Messrs. Mortimer and Herbert Fleishhacker, bankers of San Francisco, represent the Western capital, while the Eastern capital is represented by Messrs. Franklin Remington, president of The Foundation Company of New York; and John F. Bush, now vice-president and general manager of the new company, but only until recently, for many years connected in executive position with one of the largest electrochemical companies in the East.

The company has a very broad charter, and anticipates entering the electrochemical and electrometallurgical field extensively on the Pacific Coast. Products which will be manufactured here by this new enterprise are such as cyanide, aluminum, various ferro alloys, such as ferrosilicon, ferrochrome, and others, calcium carbide, nitrogen fertilizers, zinc and potassium chlorate.

The first installation is now being erected at Pittsburg, California. A most favorable site has been purchased, comprising some 40 acres, facing on the San Joaquin River. Service from both the Southern Pacific, as well as the Santa Fe, is obtained at the site, as well as water transportation on the river. Power is furnished by The Great Western Power Company, one of the largest power producers on the Coast, at very favorable rates.

The plant now under construction will turn out caustic soda, extensively used by soap manufacturers and oil refineries, and bleaching powder, used as a disinfectant and bleaching agent—it covers 15 acres of ground, and will cost $600,000. No explosives of any kind will be manufactured. This plant is the first of its kind west of Detroit, and the only one on this continent on tidewater.

The directors of the new organization are: Mortimer Fleishhacker, president, San Francisco; John F. Bush, vice-president and general manager, San Francisco; Arthur Lilienthal, secretary, San Francisco; Franklin Remington, New York City; Herbert Fleishhacker, San Francisco; Lem W. Bowen, Detroit, Michigan; J. W. Beckman, San Francisco; Sigmund Stearns, San Francisco; Louis Bloch, San Francisco.

LETTERS TO THE EDITOR.

Increasing the Range of the Electric Range.

Sir:—I have read with much interest your editorial in the issue of February 26th of the Journal of Electricity, Power and Gas, and am quite sure that you have touched upon one of the most important phases in connection with the work of developing the electric range business.

As a member of the Electric Range Committee appointed by the National Electric Light Association to bring in a report on this matter at the convention to be held in Chicago next May, I have had occasion to make a thorough investigation regarding the merchandising problems peculiar to the business, and in answer to my inquiries I have found that one of the principal difficulties in selling electric ranges is a general lack of knowledge on the subject of cooking by electricity.

It appears that a very small percentage of the consumers of any electric company seem to know that general cooking can be done by means of electricity, and those consumers who know anything about it as a rule have a very vague idea of the subject.

The public needs to be informed at the present time not so much regarding the advantages of one particular manufacturer's range over another as on the broad question of electric cooking, and after a consumer of a central station is informed he needs to be frequently reminded regarding the many advantages accruing from the use of the electric range for cooking purposes.

Concerted and co-operative educational edvertising by the manufacturers of electric ranges is what is needed at the present time, and if this work is done thoroughly by the manufacturers, the central stations will gladly contribute their share and utilize the pages of local newspapers in helping to spread the story regarding the usefulness of the electric range, and the advantages of electric cooking.

S. M. KENNEDY,

General Agent, Southern California Edison Co.

Sir:—We greatly appreciate the editorial which appeared in your magazine of February 26th on the electric range advertising situation. We will certainly follow this matter with the range manufacturers who are doing business in our territory.

Very truly yours,

C. R. PUTNAM,

Sales Manager Utah Power & Light Co.

Sir:—In line with your editorial suggestion of February 26th, I am writing various range manufacturers and also the Society for Electrical Development with the idea of interesting them in some form of general advertising to supplement our local activities relative to the sale of electric ranges on the Pacific Coast

I must take exception to your statement, however, that the best prospects for electric ranges are in non-gas competitive territories, inasmuch as we have been just as successful in selling ranges to gas users as we have to other classes of customers.

It is our impression that a national campaign of advertising through popular magazines similar to that which the Hotpoint company is planning to undertake will be very effective and of much assistance to the central stations and others selling electric ranges.

Yours very truly,

E. A. WILCOX,

Heating Expert Great Western Power Co.
Los Angeles, Cal.

Sir:—I have read your editorial in the Journal of Electricity, Power and Gas suggesting a co-operative local advertising campaign and I agree with you that in this case local advertising will bring much better results than national advertising, although I believe there are a great many eminent advertising men who take the opposite view that the greatest results are obtained from national advertising.

It certainly will give me great pleasure to write to the various district managers of the manufacturers of electric ranges, suggesting that advertising of their product could be most effectively done in small country weeklies and farm papers, at least for this particular section of the country.

Yours very truly,

G. B. McLEAN,

Sales Manager, Pacific Light & Power Corporation.

Sir: Referring to the editorial in the Journal of the 26th ultimo, on the subject of electric ranges, I have to advise that I fully agree with you that it is necessary for the manufacturers to go into the advertising very extensively, so as to create a general demand among housewives for the electric range, particularly in non-gas territory. We are giving this matter attention as far as our company is concerned, and are endeavoring in every possible way to impress upon the different manufacturers the absolute necessity of their doing their share in this work. I think I am safe in saying that on the whole the manufacturers are showing their willingness to do their share, although at the present time they are somewhat handicapped on account of the patent situation. As this seems to be fairly well cleared up now, I think we can look for greater activity in the advertising line in the very near future.

Yours very truly,

S. V. WALTON,

Manager Commercial Department,
Pacific Gas & Electric Company.

An electric copper smelter was recently installed at St. Johns, N. F., and at the initial test it is reported the plant worked admirably and a high grade of copper was produced, the "run" being made on material from Little Bay copper mines. The capacity of the plant exceeded the expectations of the expert here, who claims it will smelt about 1000 pounds of ore per hour. Operations on a commercial basis will be conducted by the Hydro Electric Smelting Company, Ltd., the capital of which is local. This company owns Little Bay mines, where it is claimed an abundance of ore exists on the surface, having been left by a company operating there several years ago, when a fall in the price of copper did not warrant a continuance of operations.

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NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Increase in Supply Costs

The increasing cost of supplies is now a serious problem in every branch of the electrical industry. This, coupled with the difficulty in obtaining delivery, is creating a condition where the buyer seeks the seller. Even many large companies have been caught unprepared in this emergency, as the rise in price had not been sufficiently foreseen.

Fundamentally, the increased cost of copper has been responsible for this condition, as copper is an important constituent in most electrical equipment. Statistics show that the United States is consuming copper at the record rate of two billion pounds per annum, which is ten million pounds a month short of the American smelting capacity. That most of this is being used for local industrial purposes is shown by the fact that copper and brass exports are less than before the war.

On the Pacific Coast, it is practically impossible to buy copper in less than hundred pound lots for earlier than July delivery—and this at prices close to thirty cents. Notwithstanding this high price, the demand continues to increase. Furthermore, it is the opinion of John D. Ryan, president of the Anaconda Copper Company, that "consumption will at least maintain its present level and that peace in Europe will bring an enormous demand to replace depleted stocks."

Other raw materials used in electrical work, such as steel and rubber, are likewise at high price levels, and as a consequence the prices of finished products are advancing rapidly, or, as is the equivalent, discounts are being reduced.

In a number of cases it is impossible for Western plants to get delivery at any price. Manufacturers are indifferent as to whether they make deliveries. Even after an order is placed the customer has frequently been notified that stock has been so depleted during the interval between the time that a quotation was made and the time that the order was placed that it could not be filled.

The greatest sufferers have been electrical contractors who have bid on construction work without figuring the possible change in prices during the interval that elapses between the time that an estimate is made and a contract awarded. In order to prevent future trouble on this account it is suggested that a clause be inserted in all bids, providing proportionate prices dependent upon changes in the cost of materials. Bids have been too low in the past, and are now certainly too low in proportion to cost. It is surely opportune for electrical contractors to have an understanding now on this matter and to set safe standards for future work.

With the ultimate return of normal conditions those firms who have done their best to serve their customers even in small matters will be the most likely to retain future custom. For, even, in business, gratitude is much more than "a lively appreciation of favors yet to come." The present condition is unequalled in the experience of most men now in busi-

ness, but they well may profit from the experience of others in that it is only true service that maintains and retains trade.

The Shields Bill

After four weeks' debate the Shields navigable stream water power bill has passed the Senate by a vote of forty-six to twenty-two and now goes to the House. That this notable result has been attained, notwithstanding the distractions incident to war and preparedness, should be a matter of congratulation to every one interested in the development of our latent water powers, which, like a sleeping giant, need but be put to work to create new wealth and support new peoples on lands now disused. This is the most notable Congressional recognition of Western needs to date.

The Shields bill, as it passed the Senate, is a splendid, practical measure. It will permit of the harnessing of water power in many parts of the country. Nor is this all. While Congress is not likely at the present session to make any great appropriations for the improvement of rivers and harbors, the great hydroelectric developments made possible by the enactment of this measure will make many rivers navigable far into the interior by private capital instead of by public taxation.

Briefly stated, the bill gives authority to the Secretary of War to approve a fifty year permit for the construction, maintenance and operation of dams and accessory works for the development of water power if, in his judgment, navigation will be benefitted, public purposes best served and conservation of water resources promoted. It provides that navigation facilities shall at least be equal to those existing prior to the new construction, that reasonable charges for the privilege and reasonable costs of federal investigation shall be paid and that a reasonable rental be paid for public lands occupied, the "reasonableness" to be determined by the Secretary of War, who is also to formulate all regulatory measures.

It is believed that this bill fully protects the public interest and yet provides sufficient incentive to justify the power developer in soliciting private funds. If passed by the House this bill should usher in an era of low head power developments exceeding in capacity the high head plants which have already made the West pre-eminent electrically. The power thus released for human utilization will make possible many irrigation and reclamation projects as well as materialize plans for electrochemical and electrometallurgical industries. Its probable enactment will mark an epoch in this electrical age.

With the Shields bill yet to pass the House and the Meyers' modification of the Ferris bill yet to pass the Senate, only half the action necessary to provide needed relief has been taken. Vigorous agitation against both these measures is being conducted by Gifford Pinchot and his followers, who seem to look upon these measures as a means of rescuing themselves from political obscurity. It is a fact greatly to be regretted that matters so vital to the economic progress of the West are at the mercy of politicians, who apparently value their own preferment above the common welfare.

Need for Employment Departments

One of the problems which perplex public utility operators is that of obtaining and retaining competent help. Wages constitute the largest single item in the cost of operating utilities and too frequently represent the least efficient return. The problem naturally divides itself into two heads—selection and retention.

Efficient methods in the selection of workers is an important factor in the subsequent efficiency of the worker. Proper system in the hiring of men will often obviate the necessity of firing them frequently. The experience of big companies has shown that a central employment bureau is preferable to individual action by the several foremen in direct charge of work.

Just as the centralized purchase of material by a purchasing agent is now standard practice, so should scientific selection of labor by a competent employment bureau supersede the present hap-hazard method, or rather lack of method, found in many establishments. It not only provides employes better fitted to the duties they are to perform, but also relieves executives of a task to which they may not be specifically fitted and saves their time.

Aside from the advantage of fitting men to their jobs and jobs to their men, such a plan promotes the esprit de corps of an organization. It knits them together more compactly, gives them the same ideals and enthuses them with the same spirit. In the public utility business, especially, it is desirable to have all employes in thorough sympathy with the public service company and its work. The influence of radical socialists is not always for the best, either among other employes or upon the public served. Each company has a small army of employes who can do much to make or mar favorable public attitude toward the company.

Furthermore a labor bureau eliminates favoritism and patronage in the selection of workers. A man is hired, not because he is a relative, a fellow countryman, or a member of the same society, but solely because he complies with the specifications required for a job and will provide an adequate return upon the investment involved in hiring him.

There are men, and more particularly women, who because of their intuitive power of character analysis, their painstaking attention to such detail as the keeping of records and their broad sympathy, make ideal recruiting officers. Their function is to recommend suitable help, to supervise transfer of misfits and to look after welfare work.

Due consideration of the welfare of workers is an aid to their efficiency of performance and to their retention. As the investment in each employe of a public service corporation is close to three thousand dollars it is evident that the retention of a good man is equally as important as his proper selection. Retention is easier when the relationship between employer and employed is close and sympathetic, as it is thus possible to have a mutual understanding and preserve the mutual interests. This can be accomplished by safety, athletic, debating, social and musical clubs, establishing play grounds and parks, all of which might well come under the supervision of the employment bureau.

PERSONALS

F. J. Quinn of the Manhattan Electric Supply Company is at Portland.

S. B. Gregory, Pacific Coast manager of the Arrow Electric Company, is in Portland.

Ira J. Wolfe of the Pittsburg Specialties Company, at San Francisco, is leaving for a trip into the San Joaquin Valley.

E. N. Fobes of the Fobes Supply Company of Seattle returned to the North after spending a week at San Francisco.

Paul Lebenbaum, electrical engineer with the Southern Pacific Company at Portland, was in San Francisco this week.

Gus Flannigan of the Electrical Engineering and Supply Company at Stockton, Cal., was a recent business visitor at San Francisco.

M. A. Bryte, Western representative of the French Battery and Carbon Company, has recently returned to San Francisco from an Eastern trip.

A. S. Kalenborn, electrical engineer with the San Joaquin Light and Power Corporation, has returned to Fresno after a brief visit to San Francisco.

A. A. Brown, assistant sales manager of the Westinghouse Electric and Manufacturing Company of New York, is a recent arrival at San Francisco.

E. G. Gauntlet, of the Safety Insulated Wire and Cable Company, who has been confined to his home owing to an operation, is now on his feet again.

Geo. E. Scarfe has resigned as superintendent of the Nevada district of the Pacific Gas & Electric Company, after sixteen years' service, being succeeded by **John Werry.**

L. M. Edwards has been made foreman of the Pacific Gas and Electric Company's de Sabla plant, following the transfer of **J. R. Carl** to the company's San Jose district.

L. F. Leury, formerly assistant to **Guy C. Bailey,** chief electrical and mechanical engineer at the Exposition, is now on the engineering force of C. C. Moore & Co., engineers, of San Francisco.

James H. Gilhuly of the Western Conduit Company has returned to San Francisco from Los Angeles, reporting that the new conduit ordinance has made business prosperous for all conduit companies.

H. G. Aylsworth, of the Aylsworth Agencies Company at San Francisco, is going East the latter part of this month to look the situation over and visit the various factories represented by his firm.

C. G. A. Baker, vice-president and treasurer of Baker-Joslyn Company, is on a trip in the Northern territory. After spending several days at the Seattle branch of the company, he will return to San Francisco about the 21st inst.

F. A. Wood, of the Gamewell Fire Alarm System, is now at Los Angeles. This firm recently completed a contract for public fire alarm system for Corning, as well as one for Phoenix, Arizona, and Carson City, Hollister and Gilroy.

Paul M. Lincoln, engineer of the Westinghouse Electric and Manufacturing Company of East Pittsburg, Pa., and past president of the American Institute of Electrical Engineers, is expected to arrive at San Francisco in the near future.

W. T. Goddard, chief engineer of the Locke Insulator Manufacturing Company of Victor, N. Y., has been making an exhaustive study of the new conditions of the high tension transmission lines on the Coast, planning for a new type of insulator. He was a visitor at their Western representatives, Pierson-Roeding Company, of San Francisco, last week, and is now in California.

GREAT WESTERN POWER CABLE LAYING.

The laying of the shore end of the new San Francisco Bay cable of the Great Western Power Company was made the occasion of a pleasant party on the morning of March 14th, when the officials of the company and a number of invited guests inspected the new method devised by General Superintendent E. W. Beardsley. In less than an hour's time the cable was successfully laid from Yerba Buena Island to join a piece laid from the Key Route mole. Following is the list of those invited:

Alberger, W. R., vice-president and general manager San Francisco-Oakland Terminal Railways.
Babcock, A. H., electrical engineer Southern Pacific Co..
Beardsley, E. W., general superintendent Great Western Power Company.
Bell, J. P., Pacific Coast manager, Standard Underground Cable Company.
Brierly, F. A., The Pacific Telephone & Telegraph Company.
Bivens, T. E., United Railroads of San Francisco.
Briggs, W. W., general agent Great Western Power Company.
Bibbins, T. E., local manager General Electric Company.
Britton, J. A., vice-president and general manager Pacific Gas & Electric Company.
Brown, H. F., Metal Weld Company, San Francisco.
Burkett, C. W., chief engineer The Pacific Telephone & Telegraph Company.
Crawford, T. O., engineer California & Oregon Power Company.
Davis, W. J., Pacific Coast engineer General Electric Company.
Downing, P. M., engineer hydroelectric operation, Pacific Gas & Electric Company.
Demerritt, Captain H. L., United States Engineer Corps.
Earl, Guy C., vice-president and general counsel Great Western Power Company.
Eckart, Nelson, assistant city engineer, San Francisco.
Edgerton, E. O., member California Railway Commission.
Euler, W. G. B. E., superintendent of operation, Great Western Power Company.
Flannagan, E. W., assistant superintendent telegraph, Southern Pacific Company.
Fleishhacker, Mortimer, President Great Western Power Co.
Fleishhacker, Herbert, president Anglo and London-Paris National Bank, and member of Federal Reserve Bank.
Fogalsang, T. E., superintendent of distribution, Gerat Western Power Company.
Frieze, A. C., of A. C. Frieze & Co., San Francisco.
Galloway, J. D., consulting engineer, San Francisco.
Goodwin, W. L. general sales manager Pacific States Electric Company.
Hall, Chaffee E., assistant general counsel Great Western Power Company.
Halloran, A. H., managing editor "Journal of Electricity, Power and Gas."
Hood, John, local engineer General Electric Company.
Ham, P. W., engineer Great Western Power Company.
Hardie, Carl, city electrical engineer, Oakland.
Harris, Geo. H., general superintendent San Francisco-Oakland Terminal Railways.
Heise, C. E., district manager Westinghouse Electric & Manufacturing Company.
Hoar, F. E., electrical and gas department, California Railroad Commission.
Jollyman, P. J., Pacific Gas & Electric Company.
King, Joseph J., president Chamber of Commerce, Oakland.
Keith, W. W., harbor manager, City of Oakland.
Knott, L. A., general sales manager Standard Underground Cable Company.
Kendall, E. J., claims and right of way agent Great Western Power Company.
Leffler, C. S., assistant to general agent Great Western Power Company.
Koontz, J. A., electrical engineer Great Western Power Co.
Lisberger, S. J., engineer electric distribution, Pacific Gas & Electric Company.
Loveland, H. D., member California Railway Commission.
Long, E. H., district superintendent of plant, The Pacific Telephone & Telegraph Company, Oakland.
L'Hommedieu, W. P., engineer Westinghouse Electric & Manufacturing Company.
Martin, C. R., sales manager Allis-Chalmers Company.
McKay, M. S., San Francisco & Sierra Power Company.
McKee, Paul, California & Oregon Power Company.
Meredith, Wynn, of Sanderson & Porter, engineers.
Messner, L. M., division superintendent of lines, Western Union Telegraph Company.
Mynard, C. E., assistant treasurer Great Western Power Co.
Newman, Jerome, assistant state engineer and chief engineer of Board of State Harbor Commissioners.
Ord, J. L., division superintendent of plant, Western Union Telegraph Company.
Ost, Paul, electrical engineer, City of San Francisco.
Pahl, A. J., K. P. F. Electrical Company, San Francisco.
Patterson, F. C., general sales department, General Electric Co.
Ryan, Professor H. J., professor of electrical engineering, Stanford University.
Rosener, Leland S., consulting engineer, San Francisco.
Rosborough, Jos. J., postmaster, Oakland.
Sachse, Richard, chief engineer California Railway Commission.
Spaulding, W. H., assistant secretary Great Western Power Co.
Smith, Frank W., general purchasing agent Great Western Power Company.
Stevenson, V. V., Postal Telegraph Company.
Smith, E. M., engineer Standard Underground Cable Company.
Sawyer, T., United States Steel Products Company.
Siever, W. H., manager wire products department, United States Steel Products Company.
Teague, W. T., division superintendent of plant, The Pacific Telephone & Telegraph Company.
Thelen, Max, president California Railroad Commission.
Trowbridge, H., Jno. A. Roeblings Sons Co., San Francisco.

Van Norden, R. W., consulting engineer, San Francisco.
Wilson, C. J., Pacific Gas & Electric Company.
Webster, Fred, district manager Allis-Chalmers Company.
Weeks, Geo. K., president San Francisco-Oakland Terminal Rys.
Woodridge, J. E., Ford, Bacon & Davis, engineers, San Francisco.
Woodward, F. H., manager Oakland division Great Western Power Company.
Wyche, T. J., chief engineer Western Pacific Railway Company.

TRADE NOTES.

The Mechanical Installation Company, now located with offices and shop at 181-9 Second street, San Francisco, in need of more room for their work shop, are moving to 115 Main street. Their offices, however, will be located at the same place as formerly. This company has recently installed a large generating unit for the Universal Gas Company.

Keeler White Company, representatives of the Appleton Electric Company and the W. J. Murdock Company, have moved from their old quarters at No. 680 Howard street to No. 221 Second street, San Francisco, with larger and roomier quarters. Mr. White announces that owing to the increased business this was really necessary. The company's present quarters are much more advantageously located than formerly.

The Central Electric Company of San Francisco has moved from 618 Mission street to 175 Jessie street, opposite the Builders' Exchange, into larger quarters. They have added a small stock of retail fixtures to their business. This company has recently secured wiring contracts for the Women's Athletic Club, a four-story building, out of Bliss & Faville's office, also wiring for Congressman Kent's home at Kentfield, and Capital National Bank building at Sacramento.

The Morrison Electric Company, 111 W. Park street, Portland, S. C. Jaggar, manager, has leased and occupied additional space in the Pittock Block location and has established one of the most complete electrical fixture shops in the city there. The old store at 353 E. Burnside street has been closed and the entire stock carried at the W. Park street store and assembling plant, which gives the company unusual facilities for handling all kinds of electrical repairs, contracting fixtures, as well as equipment lines.

H. B. Squires has moved to 583 Howard street, San Francisco, next door to his old location. Mr. Squires finds with an extended line of Cutler Hammer and National India Rubber Company's goods that more room is necessary to meet the growing demand and has secured this fine loft with 8250 square feet floor space to be divided between the two companies mentioned. Mr. Squires announces that he has recently received two carloads of the National India Rubber Company's products. The quarters are commodious, well lighted, with automatic elevator, which makes them easily accessible. Mr. Squires has just left for Seattle and Portland on a business trip.

A new branch office has been established at San Francisco by The Bristol Company at 727 Rialto Bldg., and one of their sales engineers, B. J. Klein, has been appointed Pacific District Manager and will have his headquarters in this new branch office. In connection with the extensive exhibit of Bristol Recording and Indicating instruments, set screws and belt fasteners at the Panama-Pacific Exposition, a great interest in the products manufactured by The Bristol Company was evidenced by customers located in the Pacific Coast territory and the new branch office has been established in order to better serve the interests of these customers. Mr. Klein is a mechanical engineer and instrument expert, having had a long experience with the Bristol Company including a period of more than six years as Chicago district manager, and having been located at San Francisco a year already as manager of The Bristol Company's exhibit at the Exposition.

MEETING NOTICES.

San Francisco Electrical Development and Jovian League.

Arthur E. Rowe presided in characteristically snappy fashion as chairman of the day at the luncheon on March 8th. After a number of good vocal selections he introduced Edward Rainey, secretary to Mayor Rolph, of San Francisco, who gave an interesting talk on the recent improvements in municipal affairs. Great interest is being developed in a rejuvenation which First Tribune Murray Orrick and Second Tribune A. E. Wilcox plan early in May.

San Francisco Engineers' Club.

An enjoyable smoker and pow-wow was held at the club rooms on the evening of March 10th, over one hundred members being in attendance. The feature of the evening was a mock trial, Mr. George Dillman being the defendant. By a series of remarkable legal processes, however, W. W. Briggs, who had been acting as judge, was put on the stand and found guilty of the same offense charged to Mr. Dillman, the latter's case being dismissed. A number of moving pictures, including one on the advantages of electrical farming, were shown through the courtesy of the General Electric Company. Wynn Meredith acted as chairman of the entertainment committee which arranged the programme.

Los Angeles Jovian League.

The attendance at the luncheon Wednesday, March 8th, taxed the capacity of Christopher's large banquet hall to the limit. President Holland wore a broad smile, as did Harry Sessions, editor-in-chief of the "League Bulletin," the breezy weekly reminder, a "drawing card" in itself. R. H. Hess, manager of the Caldalite Company, speaker of the day, introduced Chas. R. Jarvis, Los Angeles representative of the Christian Science "Monitor," who spoke on "Journalism, Its Opportunity and Achievement." In a plea for clean, wholesome journalism, regardless of denomination, he asserted that the crying need of today is the clean newspaper, devoid of all sordid, sensational and criminal news. He traced the growth of the "Monitor" from a small obscure publication in 1908, to its present unique position as the only newspaper in the United States free from provincialism, and with the aim in view to make it the greatest newspaper in the world. A committee consisting of W. J. Gracey, G. E. Arbogast and E. C. Ebert, was appointed by President Holland for the purpose of completing arrangements for an electrical show to be held in conjunction with the "Pure Food" Exposition which opens March 15th. "Some violinist" in the person of Mr. Bourn Jones, dispensed the harmony for the occasion, and his splendid program was heartily applauded.

NEW CATALOGUES.

No. 5 of the Westinghouse Lamp Company's salesmen's lamp handbook series contains arguments and methods of presentation to induce various classes of prospects to replace gas lighting or less efficient forms of electric lighting with Mazda lamps.

Hubbard & Company of Pittsburg have issued a complete catalog of standerd pole line hardware and Peirce specialties. The book contains 260 pages, 8½ by 10 inches, and is printed on a suede finish offset paper, with dark green, flexible, paper cover. The 260 pages and 616 illustrations in the book are divided into 16 sections, in each of which material is grouped according to the purpose for which it is used, as, for instance: guying material, crossarms and fittings; high tension arms and fittings; telephone and telegraph wiring; cable material, etc. An abridged listing of Hubbard shovels and track tools is given, together with a description of the manufacture and use of Bates expanded steel poles.

NEWS NOTES

ILLUMINATION.

TACOMA, WASH.—The city is considering ornamental lights for two city parks.

LOS BANOS, CAL.—The board of trustees has awarded a franchise for a gas plant to W. H. Worswick.

BISHOP, CAL.—Harry Tsheppe has plans under way for establishing a plant here to supply gas to Bishop residents.

ALBUQUERQUE, N. M.—A lighting contract for the Y. M. C. A. Building has been let to M. Nash. Work will begin at once.

BAKERFIELD, CAL.—J. F. Endert has secured a contract from T. W. McManus to put in street light standards and lights in Highland Tract.

OAKVILLE, WASH.—The council is considering the purchase of the town lighting plant from Frank Leisner, and operating it as a municipal utility.

LOS ANGELES, CAL.—The city council has adopted the report of the board of public works with reference to the lighting of ornamental posts on various streets.

SANTA BARBARA, CAL.—Ornamental lights are to be placed in the Riviera district, the contract for the work having been awarded to the Reynolds Electric Company.

ORANGE, CAL.—The trustees have approved the contract with the Southern California Edison Company and the new light extension will be completed about April 1st.

BOISE, IDAHO.—The town of Albion has been granted a certificate of public convenience and necessity for the construction and operation of a municipal electric light plant.

LOS ANGELES, CAL.—The board of supervisors has made an order calling an election for the formation of the Graham Lighting District with amended description of boundaries.

HUGHSON, CAL.—Hughson was organized as a lighting district at an election held recently. The proposed plan for lighting contemplates 20 100 watt lights distributed over the district.

HUNTINGTON BEACH, CAL.—An ordinance adopting specifications for the installation of conduits, posts and lights for ornamental street lighting has been passed by the board of trustees.

SANTA ANA, CAL.—Lamps, poles and wire are now on hand and the lighting committee and the Palmer Motor Shop are ready to begin the installation of an ornamental lighting system.

BAKERSFIELD, CAL.—W. E. Drury, chairman of the city improvement committee of the chamber of commerce, has appointed Herman Dumble and W. E. Benz as a committee to take up the matter of street lighting.

SAN BERNARDINO, CAL.—The city clerk has been instructed by the city council to advertise for bids on a five year contract for electric current for the street arc lighting system, as the present contract expires this month.

TACOMA, WASH.—A landslide at La Grande on March 7th seriously damaged the Tacoma municipal power plant, carried away 47 ft. of the tramway back of the powerhouse and piled tons of earth and rock against the building.

FRESNO, CAL.—The trustees have awarded the contract for the installation of 13 standard electroliers on J street between Merced and Tuolumne streets, and 3 on Tuolumne between I and J streets to the Central State Electric Company for $1278.

BETTERAVIA, CAL.—The San Joaquin Light & Power Corporation is installing a 2000 kw. steam station here to act as an auxiliary to their hydroelectric transmission. The units are being transferred from the Bakersfield steam plant. This service is being installed to guarantee continuity of service to the sugar refinery which is being completely equiped with electric motors.

TRANSMISSION.

HEMET, CAL.—The Hemet Milling & Power Company has sold its plant to the Southern Sierras Power Company for $4278. The consolidation will likely be effected by April 1st.

MARYSVILLE, CAL.—The Las Plumas power plant of the Great Western Power Company, which recently completed a 1000 ft. flume, the pipe being 72 in. diameter, is planning to install two similar flumes and two more units at its mountain plant. The work will commence within a few months.

SAN FRANCISCO, CAL.—The engineering department of the Great Western Power Company has completed working drawings for the new class-A substation which will be erected on Bush street west of Grant avenue at a cost of $100,000. A complete steel frame is specified and figures for the steel work are now being taken. The balance of the work will be let in a general contract.

LOS ANGELES, CAL.—A resolution has been passed by the city council that it is necessary for municipal purposes that permanent easement and right of way be acquired by condemnation for the purpose of constructing and operating electric power transmission lines and telephone lines, extending from a point in Inyo county to a point in Los Angeles county and the city attorney has been authorized to institute procedings in the superior court for said condemnation, and to prosecute same to final judgment.

TELEPHONE AND TELEGRAPH.

RICHMOND, CAL.—It is announced the Pacific Telephone & Telegraph Company will erect a central exchange building here this year.

HOLTVILLE, CAL.—A contract has been awarded for the erection of a new building for the Imperial Telephone Company, which will be completed within sixty days.

NORTH YAKIMA, WASH.—E. F. Keyes, manager of the Yakima Valley Telephone Company states that arrangements are under way for the construction of a line to Harrah.

AUBURN, CAL.—The city trustees have granted Miss Alfarata Hall of the Placer Telephone Company, permission to use a short distance of pole line in this city that has been abandoned by the Pacific Gas & Electric Company.

CHEHALIS, WASH. — The Independence Telephone Company of the Cowlitz district has practically decided to dispose of the Chehalis-Ethel, Chehalis-Toledo, Toledo-Winlock and Toledo-Ethel telephone lines. The Farmers' Independent association of Salkum has decided to dissolve the association at an early date.

SAN FRANCISCO, CAL.—Architect Willis Polk states that plans are practically completed for the construction of the new Western Union building, which is to be erected on the property of the McCreery Estate at the northeast corner of Montgomery and California streets. The building will be 10 or 12 stories high and of the class A type throughout. The first and second floors, basement and possibly one or two other floors will be occupied by the Western Union. The rest of the building wil be arranged for offices.

TRANSPORTATION.

EAST SAN DIEGO, CAL.—The Board of Trustees has awarded a franchise for the extension of the University-avenue car line eight blocks, from Fairmount to Euclid avenue, to the San Diego Electric Railroad Co.

SALEM, ORE.—Surveys are being made for an electric railway from Salem to Bend. The fact that the line is announced to use electric power tends to confirm the belief that the Hill interests are in control of it, as their policy is to electrify their lines where possible.

ALBUQUERQUE, N. M.—George Roslington, president of the City Electric Co., has announced plans for enlarging the company's barns in Old Albuquerque. The company's operating plans contemplate steady increase in business, and every arrangement is being made to meet the growth of the city with complete service.

CORVALLIS, WASH.—Work is beginning on the electrification of the Southern Pacific's west side line from Whiteson to Corvallis. It will be some months before the machinery is delivered, but in the meantime the bonding of rails and erection of overhead wiring will be pushed. The electric sub-stations will be built at Willsdale and at McCoy, under present plans, though this has not been definitely determined.

WATERWORKS.

ALBUQUERQUE, N. M.—An election to decide whether or not the city will bond itself for $400,000 for a water plant will be held on April 4th.

OTHELLO, WASH.—The time is not far distant when the city of Othello will find it necessary to issue bonds to provide for making repairs to its water system.

MILWAUKEE, ORE.—As the result of a special election held in Milwaukee, the voters authorized the council to issue bonds of $5500 to complete the purchase of the Milwaukee Water Co.

EMMETT, IDAHO.—The city council has decided to extend the water mains on Johns avenue to Fourth street, and on De Clark avenue. It will require a carload of piping for this work.

KUNA, IDAHO.—Kuna has voted bonds to the amount of $16,000 for the construction of a waterworks plant. The supply will be obtained from a deep well and a stand pipe will be erected. Steel pipe will be used in the distributing system.

MADERA, CAL.—A petition for the formation of an irrigation district is to be presented to the Board of Supervisors on April 3rd, the proposed district to comprise about 17,000 acres. It is proposed to secure water by pumping from the wells near San Joaquin River, the pumps to be operated by electric power.

SEATTLE, WASH.—The utilities committee of the city council has gone on record as favoring a water utility bond issue of $50,000 for establishing a water stand pipe and pumping station at the Maple Leaf reservoir. The stand pipe and pumping station and the necessary feeder mains will cost $50,000. The mains and hydrants in the district will cost $80,000, of which property owners will be required to pay $70,000.

BUHL, IDAHO.—At a meeting of citizens of Buhl to determine the advisability of pumping water up from Clear Lake, a majority expressed themselves as favoring the project, providing it can be done without increasing the water rate more than 50 per cent. Captain Hazzard and Councilman Koppelman favored the Clear Lake water system. A hydraulic engineer of Pocatello estimated that a system of 300,000 gallons per 24 hours capacity could be built for $50,000, and a plant four times as large be built for $90,000. The city council will make further investigations.

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B-1 Baker-Joslyn Company.....
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